The Veliger 46(4):351–354 (October 6, 2003)

THE VELIGER
© CMS, Inc., 2003

A New Late Miocene *Zonaria* (Gastropoda: Cypraeidae) from Central Chile

LINDSEY T. GROVES

Natural History Museum of Los Angeles County, Malacology Section, 900 Exposition Boulevard, Los Angeles, California 90007, USA; lgroves@nhm.org

AND

SVEN N. NIELSEN

Geologisch-Paläontologisches Institut und Museum, Universität Hamburg, Bundesstrasse 55, 20146 Hamburg, Germany; nielsen@geowiss.uni-hamburg.de

Abstract. A new species of cypraeid gastropod, *Zonaria (Zonaria)* ***frassinettii,*** sp. nov. is described from the lower upper Miocene (Tortonian), Navidad Formation, north of Matanzas, Cardenal Caro Province, central Chile. This new species represents the southernmost record for a cypraeid species in the Western Hemisphere.

INTRODUCTION

Philippi (1887) described *Cypraea chilensis,* the first known Chilean cypraeaoidean, from Miocene strata near Caldera, Atacama Province, based on a poorly preserved internal mold that is missing from the Philippi Collection in the Museo Nacional de Historia Natural, Santiago, Chile (D. Frassinetti, personal communication, to LTG, 2001). This species was reassigned to the genus/subgenus *Luria* (*Basilitrona*) by Schilder (1941). Tavera Jerez (1979) reported *Cypraea* (*Eocypraea*) sp. from the Navidad Formation, Colchagua Province. Unfortunately, the cited material of Tavera Jerez (1979) is currently unavailable for examination. *Cypraea* sp. of Covacevich & Frassinetti (1980) is the new species of *Zonaria sensu stricto* described herein.

STRATIGRAPHY AND AGE

Darwin (1846:127) described outcrops of "yellowish, earthy sandstones, with ferruginous veins, and with concretions of hard calcareous sandstone" near Navidad, Cardenal Caro Province, central Chile that contained "shells in great abundance." He referred to these outcrops as the "Formation of Navidad." The "Piso de Navidad" of Steinmann (1895) included Paleocene through upper Miocene strata, which Brüggen (1934) divided into the "Piso de Concepción (Paleocene and Eocene) and "Piso de Navidad" (Oligocene and Miocene) formations. Tavera (1942) considered the "Piso de Navidad" to be lower Miocene. For additional stratigraphic nomenclatural details of the Navidad Formation, as well as sedimentology, see Hoffstetter et al. (1957). Tavera Jerez (1979) subdivided the Navidad Formation into three members (in ascending stratigraphic order; Navidad, Lincancheo, and Rapel) and assigned them an early Miocene age based on foraminifera. A fossil-bearing locality at Matanzas, near Navidad (SGOPI loc. 031282) was described by Frassinetti & Covacevich (1993) (Figure 1), who earlier (Covacevich & Frassinetti, 1980) produced a preliminary list of the molluscan species. The age of the Navidad Formation is still uncertain as some authors consider it to be early Miocene (Dremel in Herm, 1969; Tavera Jerez, 1979; Frassinetti & Covacevich, 1993) whereas others have supported a late Miocene age (Tsuchi et al., 1990; Ibaraki, 1992; Nielsen & DeVries, 2002) for the same localities.

Eleven non-type specimens of the new species described herein were collected from the Rada de Ranquil beds of Fuenzalida (1938) [= Piso de Ranquil of Tavera (1942)] for deposits in Arauco Province, Chile. Based on unpublished foraminiferan data, a Tortonian (early late Miocene) age was determined for this locality by Margarita Marchant (personal communication, to SNN, 2001). Based on molluscan faunal similarities we utilize this Tortonian age determination for the Navidad and Ranquil formations.

MATERIALS AND METHODS

Abbreviations used for institutional catalog and/or locality numbers are as follows: LACM, Natural History Museum of Los Angeles County, Los Angeles, California, USA; SGOPI, Departamento de Paleontología de Invertebrados, Museo Nacional de Historia Natural, Santiago, Chile; and SMF, Senckenberg-Museum, Frankfurt am Main, Germany.

Measurement parameters are defined as follows: length = greatest distance between anterior and posterior termini; width = greatest distance between lateral margins; and height = greatest distance between base and dorsum.

Our classification follows that of Schilder & Schilder (1971).

SYSTEMATIC PALEONTOLOGY

Superfamily Cypraeoidea Rafinesque, 1815

Family Cypraeidae Rafinesque, 1815

Subfamily Erroneinae Schilder, 1927

Genus *Zonaria* Jousseaume, 1884

Type species: *Cypraea zonata* Lamarck, 1810 (*non* Chemnitz, 1788) [= *Cypraea zonaria* Gmelin, 1791], by original designation. Recent, West Africa.

Diagnosis: Shell medium to large, pear-shaped; labial lip narrow, teeth elongate; aperture straight, anteriorly curved toward columella; teeth on posterior canal weak; anterior columellar tooth oblique; fossula narrow with inner marginal teeth weak or absent; anterior and posterior canals deep; spire without furrow but commonly ribbed.

Geologic range: Lower Miocene (Aquitanian) to Recent.

Geographic distribution: *Recent:* Mediterranean Sea, West Africa, and Panamic Province of western Central America and northwestern South America, *Fossil:* Italy, France, Cape Verde and Canary Islands, Puerto Rico, Jamaica, Florida, Baja California, México, Los Angeles County, California, and Chile.

Remarks: Groves (1994) reviewed the paleontological history of the genus *Zonaria* in the Caribbean and western Central America and described *Z.* (*Z.*) *emmakingae* from the early Miocene of southern California. In a review of Neogene cypraeoideans of northwest Ecuador, Groves (1997) described two new Pliocene species of *Zonaria* and refigured *Z.* (*Psendozonaria*) *telembiensis* (Olsson, 1964) from the late Miocene of Angostura Province. This is the first record of *Zonaria* from Chile.

Subgenus *Zonaria* Jousseaume, 1884

Zonaria (*Zonaria*) ***frassinettii*** Groves & Nielsen, sp. nov.

(Figures 2,3)

Cypraea sp. Covacevich & Frassinetti, 1980:285.

Diagnosis: A *Zonaria* with narrow labial lip, relatively straight aperture, weak teeth on posterior canal, and smooth narrow fossula.

Description: Shell pear-shaped, of medium size; spire covered; dorsum moderately arched; maximum height slightly posterior of midpoint; aperture relatively straight, curving posteriorly toward columella and much wider anteriorly than posteriorly; denticulation slightly coarse with smooth interstices; labial lip with 12 to 15 teeth and columellar lip with two to four teeth, fossula smooth and narrow; basal marginal callus slight to moderate; terminal canals deep.

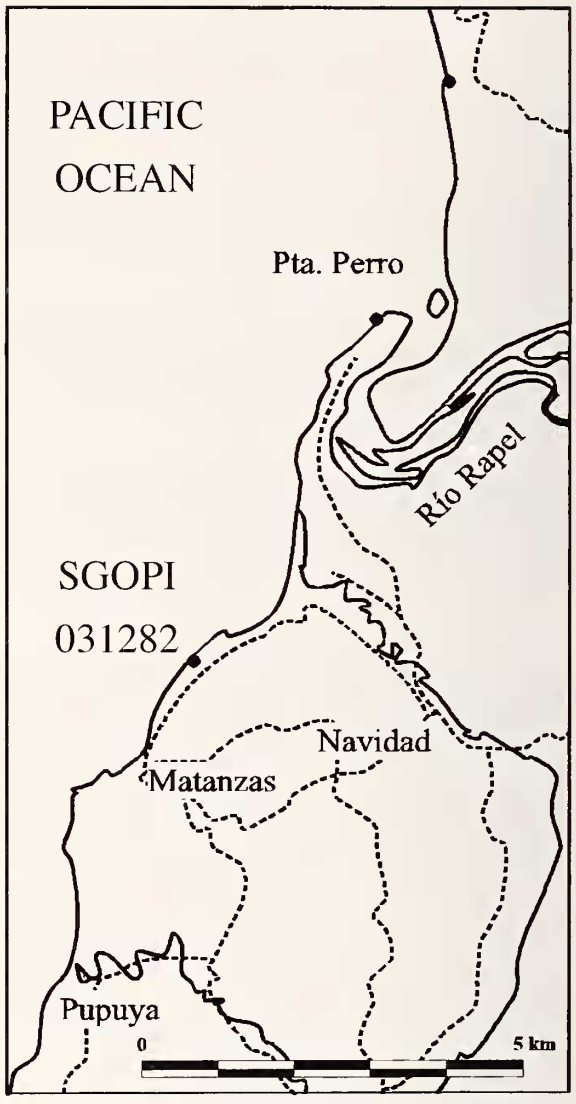

Figure 1. Index map of central Chile showing localities of the new species described herein (Type locality = SGOPI 031282). Dashed lines represent roads, solid lines represent waterways (modified from Nielsen & DeVries, 2002).

Material: The new species is represented by the well preserved holotype and paratype from the Navidad Formation, north of Matanzas, Santiago Province and 11 non-type specimens from the Ranquil Formation, north of Lebu, Arauco Province. Six non-types are deposited in SMF, two in LACM Invertebrate Paleontology (loc. 17614), and three in the reference collection of the junior author.

Type material: Holotype SGOPI.4972, Paratype SGO-

Figures 2, 3. *Zonaria* (*Zonaria*) ***frassinettii*** Groves & Nielsen, sp.nov., holotype SGOPI 4972, SGOPI loc. 031282 [length = 27.4 mm]. Figure 2. Dorsal view. Figure 3. Apertural view.

PI.4971. The holotype measures 27.4 mm in length, 16.7 mm in width, and 11.9 mm in height. The paratype measures 28.7 mm in length, 18.3 mm in width, and 13.1 mm in height.

Type locality: Tidal platform approximately one km north of Matanzas (33°57′27″S, 71°52′15″W), Cardenal Caro Province, central Chile (SGOPI loc. 031282). Early late Miocene (Tortonian), Navidad Formation.

Comparison: The new species is most similar to the morphologically variable Pliocene to Recent *Zonaria* (*Zonaria*) *annettae* (Dall, 1909) of the Panamic Province and the similarly variable Pleistocene to Recent *Z.* (*Z.*) *pyrum* (Gmelin, 1791) of the Mediterranean Sea and West Africa. *Zonaria* (*Z.*) ***frassinettii*** has a much more prominent marginal callus than either of the similar species and has finer dentition on the outer lip. The new species also resembles the morphologically variable *Z.* (*Z.*) *porcellus* (Brocchi, 1814) from middle to upper Pliocene strata of northern Italy but has coarser dentition and a wider aperture. When compared to Pilsbry's (1922) illustration of the holotype of *Z.* (*Z.*) *spurcoides* (Gabb, 1873) from the Miocene of the Dominican Republic, the new species compares favorably to the lateral view but not to the apertural view. The apertural dentition of the new species is much coarser than that of *Z.* (*Z.*) *spurcoides*.

Discussion: The excellent preservation of the new species allows for unequivocal generic and subgeneric assignment. The presence of *Zonaria* (*Z.*) ***frassinettii*** and the associated warm-water gastropod genera *Ficus, Distorsio, Echinoplioria,* and *Olivaucillaria* in the Navidad Formation (Covacevich & Frassinetti, 1980) indicates that subtropical to tropical climatic conditions existed during the Miocene in what is now central Chile. The new species represents the southernmost record for a cypraeoidean in the Western Hemisphere.

Etymology: This species is named for Daniel Frassinetti, Curator at the Museo Nacional de Historia Natural, Santiago, Chile, who collected the type material.

Acknowledgments. Klaus Bandel (Geologisch-Paläontologisches Institut und Museum der Universität, Hamburg, Germany) is thanked for field assistance and discussions on Chilean Tertiary geology and paleontology. Field work by the junior author in Chile was funded by the Deutsche Forschungsgemeinschaft (DFG) grant Ba 675/25. Donald W. McNamee and Mali Griffin (LACM Research Library) assisted the senior author in locating some obscure references. James H. McLean and Ángel Valdés (LACM Malacology) and Richard L. Squires (California State University, Northridge, Department of Geological Sciences) critically reviewed the original manuscript and added valuable comments and suggestions. Ángel Valdés assisted the senior author with translations of Spanish references. George E. Davis (LACM Crustacea) and Ángel Valdés (LACM Malacology) assisted with photography and digital image manipulations. Thomas J. DeVries and an anonymous reviewer made valuable comments which helped improve the manuscript.

LITERATURE CITED

Brüggen, J. 1934. Grundzüge der Geologie und Lagerstättenkunde Chiles. Heidelberger Akademie der Wissenschaften Mathematisch-Naturwissenschaftliche Klasse. 362 pp.

Covacevich, V. & D. Frassinetti. 1980. El género *Ficus* en el Mioceno de Chile central con descripción de *F. gayana* sp. nov. Gastropoda: Ficidae. Boletín del Museo Nacional de Historia Natural de Chile 37:281–294.

Darwin, C. 1846. Geological observations on South America. Being the third part of the geology of the voyage of H.M.S. 'Beagle.' Smith, Elder, & Company: London. vii + 279 pp.

Frassinetti, D. & V. Covacevich. 1993. Bivalvos del Mioceno marino de Matanzas (Formación Navidad, Chile Central). Boletín del Museo Nacional de Historia Natural de Chile 44:73–97.

Fuenzalida, H., 1938. Informe sobre fósiles de la zona carbonífera. Boletín de Minas y Petroleo, Chile 8(79):86–93.

Groves, L. T. 1994. New species of Cypraeidae (Mollusca: Gastropoda) from the Miocene of California and the Eocene of Washington. The Veliger 37(3):244–252.

Groves, L. T. 1997. A review of cypraeiform gastropods from Neogene strata of Northwestern Ecuador, with the description of two new species. Tulane Studies in Geology and Paleontology 30(3):147–157.

Herm, D. 1969. Marines Pliozän und Pleistozän in Nord- und Mittel-Chile unter besonderer Berücksichtigung der Entwicklung der Mollusken-Faunen. Zitteliana 2:1–159, pls. 1–18.

Hoffstetter, R., H. Fuenzalida & G. Cecioni. 1957. Chile. Pp. 1–444 in R. Hoffstetter (ed.), Lexique Stratigraphique International. V. 5, Amérique Latine, Fascicule 7, Congrès Géologique International—Comission de Stratigraphie, Centre National de la Recherche Scientifique, Paris.

Ibaraki, M. 1992. Planktonic foraminifera from the Navidad Formation, Chile: Their geologic age and paleoceanographic implications. Pp. 91–95 in K. Ishizaki & T. Saito (eds.), Centenary of Japanese Micropaleontology. Terra Scientific Publishing Company: Tokyo.

Nielsen, S. N. & T. J. DeVries. 2002. Tertiary Xenophoridae (Gstropoda) of western South America. The Nautilus 116(3): 71–78.

Philippi, R. A. 1887. Los fósiles terciarios i cuartarios de Chile. F.A. Brockhaus: Leipzig. 256 pp., 58 pls.

Pilsbry, H. A. 1922. Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo. Proceedings of the Academy of Natural Sciences of Philadelphia 73:305–435, pls. 16–48.

Schilder, F. A. 1941. Verwandtschaft und Verbreitung der Cypraeacea. Archiv für Molluskenkunde 73(2/3):57–120.

Schilder, M. & F. A. Schilder. 1971. A catalogue of living and fossil cowries. Institut Royal des Sciences Naturelles de Belgique Mémoire 85:1–246.

Steinmann, G. 1895. Das Auftreten und Alter der Quiriquina-Schichten. Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, Beilage Band 10:1–31.

Tavera, J., J. 1942. Contribucion al estudio de la estratigrafia y paleontologia del Terciario de Arauco. Anales del Primer Congreso Panamericano de Ingenieria de Minas y Geología 2:580–632.

Tavera Jerez, J. 1979. Estratigrafía y paleontología de la Formación Navidad, Provincia de Colchagua, Chile (Lat. 30°50′–34°S). Boletín del Museo Nacional de Historia Natural de Chile 36:5–176, pls. 1–21.

Tsuchi, R., T. Shuto, T. Takayama, I. Koizumi, A. Fujiyoshi, R. Nomura, M. Ibaraki, H. Duque-C, R. Tirado-S., M. Aldana-A., E. Villavicencio-R. & R. Martinez-P. 1990. Trans-Pacific correlation of Neogene geologic events. Reports of Andean Studies, Shizuhoka University, Special Volume 3:1–7.